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DNP3 Interface Reference

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Getting started with DNP3 controllers

This reference provides the information you need to set up, configure, and test DNP3 controller communications with the server.

How to use this guide

The following table lists the steps for connecting and configuring a DNP3 controller. Complete each step before commencing the next step.

Steps:	Go to
Connect and set up the DNP3 controller according to the controller's user manual's instructions	“Architectures” on page 10
Use Quick Builder to define channels	“Defining a DNP3 channel” on page 14
Use Quick Builder to define controllers	“Defining a DNP3 controller” on page 20
Enable channels and test communications	“Testing DNP3 communications with the server” on page 36
Troubleshoot communication errors	“Troubleshooting DNP3 scanning errors” on page 37
Use Quick Builder to define points	“DNP3 addresses for a point parameter value” on page 29

Related topics

“DNP3 V3.00 levels supported” on page 6
“Other documentation for DNP3” on page 7
“DNP3-specific terms” on page 8

DNP3 V3.00 levels supported

The server supports the Level 1, 2, and 3 subsets of the DNP3 V3.00 Application Layer Protocol.

Other documentation for DNP3

The latest DNP3 specification documents should be studied before configuring a controller. You can download these documents from the Document Library section of http://www.dnp.org.

DNP3-specific terms

Term	Description
DNP3	Distributed Network Protocol, Version 3
DNP3-LX	When applied to a device indicates that the device implements DNP3 Subnet Level X (1, 2, or 3).
Master	A device that initiates requests to gather data or perform controls using DNP3.
Slave	A device that gathers data or performs control operations in response to DNP3 requests from a Master, and sends response messages in return. A slave device may also generate DNP3 unsolicited responses.

DNP3 controller setup

This section describes how to set up a DNP3 controller.

Related topics

“Architectures” on page 10
“Communication settings” on page 12

Architectures

Connect DNP3 controllers to the server in accordance with the appropriate architectural diagram.

Attention

Configuring redundant ports, redundant controllers and/or redundant servers can be complex and can vary depending on the controller used and the system architecture. If you have redundancy-related problems, contact your local Honeywell representative for assistance.

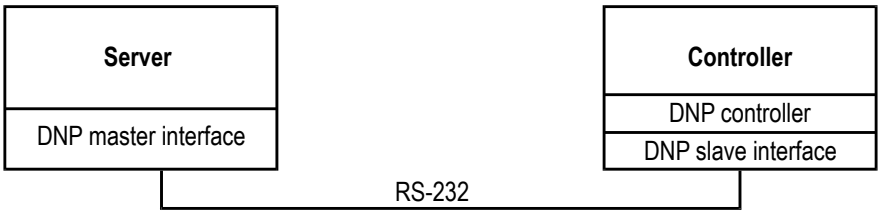

Figure 1: DNP3 point to point serial architecture

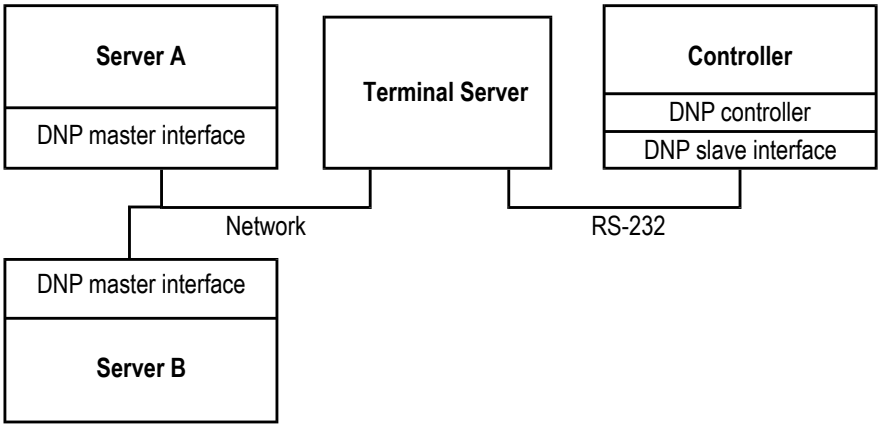

Figure 2: DNP3 redundant server serial architecture using a terminal server

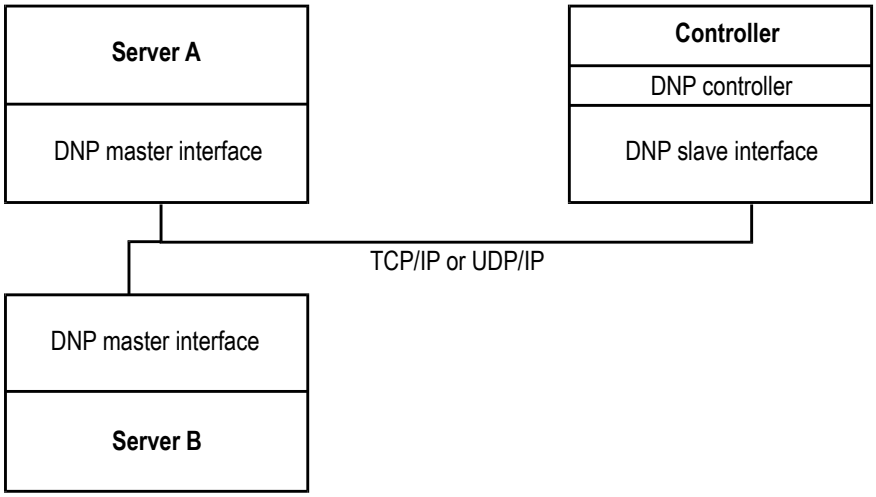

Figure 3: DNP3 redundant server network architecture

Related topics

“DNP3 channel Main properties” on page 14

Communication settings

Serial communications settings should be the same as the terminal server or server serial port, depending on which architecture is being used.

Ethernet communications settings should be the same as those used by the server.

DNP3 controller configuration and addressing

This section describes how to configure a DNP3 controller using Quick Builder. For each configuration procedure, there is detailed information covering all supported DNP3 levels.

Related topics

“Defining a DNP3 channel” on page 14
“Defining a DNP3 controller” on page 20
“DNP3 addresses for a point parameter value” on page 29
“Optimizing scanning performance” on page 34

Defining a DNP3 channel

You need to define a channel for the connection the server uses to communicate with DNP3 controllers.

To define a DNP3 channel using Quick Builder

1 Click to open the Add Items dialog box.

2 Select *Channel* from **Add Items**.

3 Select *DNP3* from **Type**.

4 Specify the Main tab property values.

5 Click the Port tab, and for **Port Type** select either:

- *LANVendor* (if an Ethernet channel is required)
- *Serial*
- *Terminal Server*

6 Specify the Redundant Port properties.

Related topics

"DNP3 channel Main properties" on page 14
"DNP3 channel Port properties" on page 16
"DNP3 channel Redundant port properties" on page 18

DNP3 channel Main properties

The Main tab defines the basic properties for a DNP3 channel.

Attention
Several of the settings described in the table are marked with a (S*n*) or (U*n*), where *n* is a number. To aid in the troubleshooting, error messages in the server log associated with one of these particular settings also contain the corresponding (S*n*) or (U*n*) text.

Property	Description
Name	The unique name of the channel. A maximum of *10* alphanumeric characters (no spaces or double quotes). Note: In Station displays, underscore characters (_) appear as spaces.
Description	(Optional) A description of the channel. A maximum of *30* alphanumeric characters, including spaces.
Marginal Alarm Limit	The communications alarm marginal limit at which the channel is declared to be marginal. When this limit is reached, a high priority alarm is generated. A channel barometer monitors the total number of requests and the number of times the controller did not respond or response was incorrect. The barometer increments by two or more, depending on the error, and decrements for each good call. To calculate an acceptable marginal alarm limit, use the formula: Square root of the number of controllers on the channel × Marginal Alarm Limit defined on those controllers (Normally, you specify the same value for all controllers on a channel). For example, if there are 9 controllers on the channel and their Marginal Alarm Limit is set to *25*, the value would be *3* (which is the square root of 9) *x 25 = 75*.
Fail Alarm Limit	The communications alarm fail limit at which the channel is declared to have failed. When this barometer limit is reached, an urgent alarm is generated. Set this to double the value specified for the channel Marginal Alarm Limit.

Property	Description
Master Address for ServerA	DNP3 data link address of the server on the DNP3 channel. Valid range is from 0–65,519, and must be unique on the channel. In a redundant server system, Server A uses this setting for its DNP3 data link address.
Master Address for ServerB	In a redundant server system, Server B uses this setting for it's DNP3 data link address.
Daemon Period	Period in milliseconds that the DNP3 daemon looks for data from the channel (serial only) and progress any outstanding requests (serial and Ethernet). Note that the DNP3 daemon processes Ethernet data as soon as it arrives. Valid range from 5 to 30,000. Default value is *50*. For Ethernet it is recommended that this is set to 100.
Read time per byte (S0)	(Only applicable to Serial and TerminalServer port.) The time in milliseconds that the DNP3 daemon allows to read a single byte. Valid range from 1 to 1,000 milliseconds. This should be set in accordance with the underlying serial communications speed. Default value is *30*.
Daemon Poll Timeout (U0)	Period in seconds that the DNP3 daemon keeps data from the device for the DNP3 scan task before deleting it. Valid range from 1 to 300 seconds. Default is *60*.
Ethernet Connect Timeout	(Applicable to LANVendor port only.) The time (in seconds) that the server waits when trying to establish an Ethernet connection to the device. Valid range is 1–999 seconds. Default value is *1*.

Daemon timeouts

Property	Description
Read (U1)	This setting has been deprecated and does not need be configured.
Class read (U2)	This setting has been deprecated and does not need be configured.
Diagnostic (U3)	This setting has been deprecated and does not need be configured.
Control (U4)	This setting has been deprecated and does not need be configured.
Time Sync Read (U5)	This setting has been deprecated and does not need be configured.
Time Sync Write (U6)	This setting has been deprecated and does not need be configured.
Request retry period (U7)	This setting has been deprecated and does not need be configured.
Item Type	Shows the channel type.
Last Modified	Shows the date of the most recent modification to this channel's property details.
Last Downloaded	This shows the date that the item was last downloaded to the server.
Item Number	The unique item number currently assigned to this item. You can change the item number if you need to match your current server database configuration. The number must be between 1 and the maximum number of channels allowed for your system.

Related topics

“DNP3 channel Port properties” on page 16
“DNP3 channel Redundant port properties” on page 18
“Defining a DNP3 channel” on page 14
“Architectures” on page 10

DNP3 channel Port properties

The Port tab defines the communication-related properties for a channel. The **Port Type** for a DNP3 controller can be:

- *Serial*. A serial communications interface, such as RS-232. See the section below titled "Serial port properties."
- *TerminalServer*. A communications link that enables controllers with a serial interface to be connected to a LAN. See the section below titled "Terminal server port properties."
- *LANVendor*. An Ethernet communications link using TCP/IP or UDP. See the section below titled "LANVendor port properties."

Serial port properties

Attention
The Serial Port settings must match the settings on your communication devices.

Property	Description
Max. Daemon Slots	Each channel's link consists of a daemon process which may run out of transaction table slots if the link is overloaded, or if there are large numbers of controllers on the link. The number of transaction table slots in the daemon may be modified by using this setting. The range is *256* to *32767*. Default value is *256*.
Half duplex polling	If selected, only one request is outstanding on the port at any instance. All logical controllers that are active on the channel are given equal 'round-robin' access to the port. When a request is in progress, subsequent requests are queued until the current request is complete or has timed out. This setting is useful if there are multiple controllers on the channel and there is at least a part of the communications pathway between the server and the controller that has ineffective flow control. If this setting is used, it is recommended that unsolicited responses be disabled on the controller. If not selected, only one request per controller is outstanding on the port at any instance. When a request is in progress for a controller, subsequent requests for that controller are queued until the current request is complete or has timed out. If there are multiple controllers on the channel this allows multiple requests to be underway at the same time. By default this option is not selected. Note that regardless of this setting, queued requests are sent out in first in/first out order; the exception is control requests, which are always processed before other types of requests such as data acquisition, diagnostics, class polling and time synchronization.
Serial Port Name	The device name of the serial port.
Baud	The number of data bits per second. The default is *9600*.
Number of Data Bits	The number of data bits used for transmission. The default is *8*.
Stop Bits	The number of stop bits used for transmission. The default is *1*.
Parity	The parity verification used on the port. The default is *NONE*.
Checksum	Set to *None* (default). (Each block in a DNP3 data link frame has a 16-bit CRC appended to it. The server handles this checksum by default in the data link layer.)
XON/XOFF	The type of XON/XOFF software flow control used to stop a receiver from being overrun with messages from a sender. The types are: • *None* (default) • *Input* (use XON/XOFF to control the flow of data on the receive line) • *Output* (use XON/XOFF to control the flow of data on the transmit line)

Property	Description
Handshaking Options	**For RS-232**: • **Enable RTS/CTS flow control**. Stops a receiver from being overrun with messages from a sender by using RTS/CTS flow control. • **Detect DCD**. Select if the Data Carrier Detect communication status line of the COM port requires monitoring (usually when using modem or microwave linking). When selected, the communications fails if the desired COM status line is not high—for example, on a dial-up link connection for a modem. • **Detect DSR**. Select if the Data Set Ready communication status line of the COM port requires monitoring (usually when using modem or microwave linking). When selected, the communications fails if the desired COM status is not achieved. **For RS-485**: • **Enable Stallion RS-485 Half Duplex**. Select if RS-232 to RS-485 is done using a Stallion EasyConnection adapter. • **Echo (Required for Stallion RS-485 ports)**. Select so that the server expects the messages it sends to the port on the transmit line to be echoed back on the receive line. Select for a Stallion EasyConnection adapter or a Black Box converter.

Terminal server port properties

Property	Description
Max. Daemon Slots	Each channel's link consists of a daemon process which may run out of transaction table slots if the link is overloaded, or if there are large numbers of controllers on the link. The number of transaction table slots in the daemon may be modified by using this setting. The range is *256* to *32767*. Default value is *256*.
Half duplex polling	If selected, only one request is outstanding on the port at any instance. When a request is in progress, subsequent requests are queued until the current request is complete or has timed out. This setting is useful if there are multiple controllers on the channel and there is at least a part of the communications pathway between the server and the controller that has ineffective flow control. If unsolicited responses are enabled, unsolicited responses from controllers are still confirmed when in this mode. If not selected, only one request per controller is outstanding on the port at any instance. When a request is in progress for a controller, subsequent requests for that controller are queued until the current request is complete or has timed out. If there are multiple controllers on the channel this allows multiple requests to be underway at the same time. By default this option is not selected. Note that regardless of this setting, queued requests are sent out in first in/first out order; the exception is control requests, which are always processed before other types of requests such as data acquisition, diagnostics, class polling and time synchronization.
Terminal Server TCP Host Name	The name and port number of the terminal server to which the channel is connected.
Terminal Server TCP Port No.	You can specify either a TCP host name or an IP address, but it must match the TCP host name used when you installed and internally configured the terminal server.
Idle Timeout	The time, in seconds, the channel waits for a successful connection to the server before closing the connection. A value of *0* indicates that the connection is never closed. The idle timeout should be set to a number greater than the fastest polling period on the channel. This also applies to the idle timeout configured in the terminal server.

Property	Description
Checksum	The type of checksum error detection used for the port. • *None* Note that each block in a DNP3 data link frame has a 16-bit CRC appended to it. The server handles this checksum by default in the data link layer.

LANVendor port properties

Property	Description
Max. Daemon Slots	Each channel's link consists of a daemon process which may run out of transaction table slots if the link is overloaded, or if there are large numbers of controllers on the link. The number of transaction table slots in the daemon may be modified by using this setting. The range is *256* to *32767*. Default value is *256*.
Half duplex polling	If selected, only one request is outstanding on the port at any instance. When a request is in progress, subsequent requests are queued until the current request is complete or has timed out. This setting is useful if there are multiple controllers on the channel and there is at least a part of the communications pathway between the server and the controller that has ineffective flow control. If unsolicited responses are enabled, unsolicited responses from controllers are still confirmed when in this mode. If not selected, only one request per controller is outstanding on the port at any instance. When a request is in progress for a controller, subsequent requests for that controller are queued until the current request is complete or has timed out. If there are multiple controllers on the channel this allows multiple requests to be underway at the same time. By default this option is not selected. Note that regardless of this setting, queued requests are sent out in first in/first out order; the exception is control requests, which are always processed before other types of requests such as data acquisition, diagnostics, class polling and time synchronization.
Protocol	TCP or UDP. Each UDP channel port built on a server must be built with a different UDP port number (the default DNP3 port number is 20000). You can select a port number for the channel link and then assign the port number for each controller on this channel link with that port number. The port numbers on the physical controller will also need to match this setting. Only one UDP channel can be built per system and only one redundant link can specify UDP as the transport protocol. If a second UDP link or channel is built or if another application on the same system is using UDP port 20000, a Winsock error 10049 will be reported in the log.

Related topics

“DNP3 channel Main properties” on page 14
“DNP3 channel Redundant port properties” on page 18
“Defining a DNP3 channel” on page 14
“Troubleshooting DNP3 scanning errors” on page 37

DNP3 channel Redundant port properties

Redundant communications relies on the controller functioning as follows:

1. Listening and responding to both ports as requested.
2. Simultaneously sending unsolicited data down both links or only sending unsolicited data down the link that most recently was used for solicited communications.

Attention

Configuring redundant ports and/or redundant servers can be complex and can vary from controller to controller. If you encounter problems implementing a redundant port, contact your local Honeywell representative.

The properties on this tab are the same as those on the **Port** properties tab, with the addition of the **Redundant Port Timeout Multiplier** property.

Property	Description
Redundant Port Timeout Multiplier	This setting can be used when Link B (the non-preferred link) is slower than Link A. The following timeouts on Link B are multiplied by this value: • Overall Data Link Layer timeout (D1) • Ack/link status timeout (D2) • Read time per byte (S0) • Fragment timeout (A2) • Response timeout (A3) • Read timeout (U1) • Class read timeout (U2) • Diagnostic timeout (U3) • Control timeout (U4) • Time sync read timeout (U5) • Time sync write (U6) Valid range is from *1* to *100*. Default value is *1*.

Related topics

“DNP3 channel Main properties” on page 14
“DNP3 channel Port properties” on page 16
“Defining a DNP3 channel” on page 14

Defining a DNP3 controller

You need to define a controller to describe each DNP3 on a channel.

To define a DNP3 controller using Quick Builder

1 Click to open the Add Items dialog box.

2 Select *Controller* from **Add Items**.

3 Select *DNP3* from **Type**.

4 Specify the **Main** tab property values.

5 Specify the Class Requests, Unsolicited Responses, and Time Synchronization settings on the **Classes, Unsol & Time Sync** tab.

6 Specify the DNP3 Data Link Layer, Application Layer, and Default Control settings on the **Time Outs and Control** tab.

Related topics

"DNP3 controller Main properties" on page 20
"DNP3 controller classes, unsolicited responses, and time synchronization properties" on page 24

DNP3 controller Main properties

The Main tab defines the basic properties for a DNP3 controller.

Property	Description
Name	The unique name of the controller. A maximum of *10* alphanumeric characters (no spaces or double quotes). Note: In Station displays, underscore characters (_) appear as spaces. For LAN–connected controllers, the name is used to look up the IP address in the TCP/IP database if you do not specify an **IP Address** property.
Description	(Optional) A description of the controller. A maximum of *30* alphanumeric characters, including spaces.
Channel Name	The name of the channel on which the controller communicates. You need to have already defined the channel in order for it's name to appear in the list.
Marginal Alarm Limit	The communications alarm marginal limit at which the controller is declared to be marginal. When this limit is reached, a high priority alarm is generated. A controller barometer monitors the total number of requests and the number of times the controller did not respond or response was incorrect. The barometer increments by two or more, depending on the error, and decrements for each good call. The default value is *25*.
Fail Alarm Limit	The communications alarm fail limit at which the controller is declared to have failed. When this barometer limit is reached, an urgent alarm is generated. Set this to double the value specified for the controller Marginal Alarm Limit. The default is *50*.
Device Address	DNP3 data link address of the controller on the DNP3 channel. The valid range is from 0 to 65,519, and must be unique on the channel.

Property	Description
Level	The controller level: • 1 • 2 • 3 For more information about these levels, see the topic titled "DNP3 controller levels."
Default Data Size	Specifies the register size to be used when not explicitly specified in the Point address. Either 16-bit or 32-bit. If you modify this option, and you want existing points to use the modified value, then you must rebuild those points.
Enable SOE	Must be set if time stamped binary inputs are to be treated as SOE (Sequence of Events). By default this option is not selected. If you select this option, you must also configure SOE on a point parameter basis. See the section "Address syntax" in the topic titled "DNP3 addresses for a point parameter value."
Enable Unsolicited Message Control	If selected, the server sends out enable (*Function code 20*) and disable (*Function code 21*) unsolicited message requests, dependant upon the controller's **Accept Unsolicited Messages** setting. Some controllers may not be able to correctly interpret these requests. If not selected, the sending of unsolicited messages is entirely controlled by the controller itself. This setting should not be selected if the physical controller is configured to never send unsolicited responses.
Request Status with Data	If selected, all subsequent points that are built use the with status variation. By default this option is not selected. If this option is modified, and you want existing points to use the modified value, then those points must be rebuilt.
Enable History Backfill	Select this if *binary input change with time*, *analog change event with time*, and *counter change event with time* objects are to be backfilled into standard history. The change values are inserted into standard history snapshots as if they were read by the server at the time of the change's timestamp. **CAUTION** Standard history averages are NOT re-averaged as part of the history backfill process and should not be considered accurate for points that have history backfill configured. The system's history initialization percentage must also be set to 100% (that is, set sysflg (file 8), record 1, word 26 to 100). The maximum number of days that can be backfilled must also be defined in sysflg (file 8, record 1, word 470). Any event data older than this number of days will be discarded and will not be inserted into history. This maximum number of days must not exceed the number of days of standard history snapshots that is configured for the system. An alarm is raised if change data is lost due to an overflow in the controller's event buffer or an overload of the history backfill task. The priority of this alarm is defined in sysflg (file 8, record 1, word 494, bits 0-1). Set these two bits only to 0 for a journal entry, 1 for low, 2 for high, and 3 for urgent alarm priority. If you select this option, you must also: • Enable the history backfill option on the server. You must also specify the maximum number of days that history will be backfilled. See the topic titled "Configuring history backfill" in the *Station Configuration Guide*. • Configure history backfill on a point parameter basis. See the section "Address syntax" in the topic titled "DNP3 addresses for a point parameter value." By default, this check box is not selected.

Property	Description
Separate Link B Configuration	If selected, the class requests, unsolicited responses, and time synchronization settings can be configured differently for each link on separate tabs within Quick Builder. This may be required if the characteristics or physical medium for Link A and Link B are different. For example, if Link A is Ethernet and Link B is serial. If you have redundant links with the same characteristics you can clear this check box and the same settings will be used for both links.
Write Deadbands to the Controller	If selected, the DNP3 interface will write Analog Input deadbands to the controller. The physical controller must also support the writing of analog input deadbands to be able to use this setting. An Analog Input deadband setting on a DNP3 controller defines the absolute amount that a value can change before it is considered significant and thus be communicated back to the server as an Analog Input Change Event. The deadband setting can be used to suppress insignificant small variations in value. The deadband setting may also be useful in reducing the amount of network used by the controller. When this is selected, the deadband for an Analog Input is calculated from the point parameter's engineering range low and high and its drift deadband percentage. Multiple point parameters built on the same Analog Input will result in the small deadband value being written to the physical controller. Care should be taken to ensure that all Analog Input addresses referenced in point parameters actually exist on the physical controller so that write deadband requests are not rejected. By default, this check box is not selected.
Rewrite Deadbands upon Controller Restart	If selected, the DNP3 interface will write all Analog Input deadbands to the controller when the physical controller restarts. This may be required if the controller resets its deadbands when it restarts. By default, this check box is not selected and is only available if the **Write Deadbands to Controller** check box is selected.
IP Address 1	(Only applicable to LANVendor port.) If redundant ports are configured, this should be the IP address of the device on link 1. If this is not specified, the controller name is used as the host name with an 'A' appended to it. If redundant ports are not configured, this should be the IP address of the device. If this is not specified, the controller name is used as the host name.
Port	For TCP/IP this is the port number on the controller to which it is connected. For UDP/IP this is the port number on the controller to where the server datagrams are sent. For UDP/IP this port number is also the port number that the server listens for datagrams from the controller(s) on and must be the same for all controllers on the channel. Each UDP/IP channel link on the server must also use a different port number.
IP Address 2	(Only applicable to LANVendor port.) The redundant IP address of the device. If this is not specified, the controller name is used as the host name, with a 'B' appended to it.
Port	For TCP/IP this is the port number on the controller to which it is connected. For UDP/IP this is the port number on the controller to where server datagrams are sent. For UDP/IP this port number is also the port number that the server listens for datagrams from the controller(s) on and must be the same for all controllers on the channel. Each UDP/IP channel link on the server must also use a different port number.
Item Type	Shows the controller's type.
Last Modified	Shows the date of the most recent modification to this channel's property details.
Last Downloaded	Shows the date that the item was last downloaded to the server.
Item Number	The unique item number currently assigned to this item. You can change the item number if you need to match your current server database configuration. The number must be between 1 and the maximum number of channels allowed for your system.

Related topics

"Defining a DNP3 controller" on page 20
"DNP3 controller levels" on page 23
"DNP3 addresses for a point parameter value" on page 29

DNP3 controller levels

Controller and Point configuration needs to be tailored according to the DNP3 controller level.

Level 1

For slave devices implementing DNP3 V3 Application Layer protocol Level 1. This is the simplest DNP3 level, typically a small end-device such as a meter or relay, whose I/O is local to the device. Typically, Level 1 devices rely on either RBE or unsolicited methods for sending data to master devices. The following controller and point configuration items are relevant:

- Point periods are irrelevant.
- Point object type, variation (such as data size and status flag) and object address are relevant.
- Reads of all controller static data (class 0) occur at the configured rate. This is inefficient, it would be better to have infrequent class 0 polls, and rely on class 1/2/3 polling or unsolicited data for more frequent updates.
- Reads of all controller event data (classes 1, 2, and 3) at the configured rate. This requires the slave assigning all required objects to the required classes.
- Unsolicited data may be sent by the controller.
- Performing point control is inefficient because class 0 reads are the only way to confirm the control was successful.

Level 2

For slave devices implementing DNP3 V3 Application Layer protocol Level 2. This is typically a large Intelligent Electronic Device (IED) or a small Remote Terminal Unit (RTU). Typically, the I/O is local to the device. Level 2 controllers are treated as Level 1 controllers with the following exceptions:

- Point periods are relevant. Periodic polling for static data (for the entire object type) at the rate determined by the fastest point scanning configured for any Point referencing that object type. Class 1/2/3 polling and unsolicited data are still far more efficient than this method.
- Class 0 reads would typically be disabled (set to 0), as they are inefficient compared to the above method.

Level 3

For slave devices implementing DNP3 V3 Application Layer protocol Level 3. This is typically a medium size slave device, such as a RTU or Data Concentrator. Level 3 controllers are treated as Level 2 controllers with the following exceptions:

- DNP3 controller read requests are for a block of objects, of the same type and period. This method replaces entire object type read used for Level 2 devices. Note that for some controllers it may be necessary for all objects in the block to exist on the controller. That is, it may be necessary for DNP3 objects to be built directly.
- Performing point control is efficient because single object reads can be performed to confirm the control was successful.

Related topics

"DNP3 controller Main properties" on page 20
"DNP3 addresses for a point parameter value" on page 29

DNP3 controller classes, unsolicited responses, and time synchronization properties

If the **Separate Link B Configuration** check box on the **Main** tab is selected, two tabs are visible; a **Classes, Unsol & Time Sync – Link A** and **Classes, Unsol & Time Sync – Link B**. The properties on these tabs are the same, one for Link A and the other for Link B.

The **Classes, Unsol & Time Sync** tab defines the class requests, unsolicited responses, and time synchronization settings for a DNP3 controller.

Class requests

Property	Description
Enable	Enables the classes to be requested. You can disable classes if your control strategy does not require the use of all classes. By default, the check boxes for each class are selected. If you clear this check box, it disables the class being requested. If events are being generated for the class, these events continue to fill the controller's event buffer. Check this setting when configuring existing controllers.
Poll Period (Seconds)	Specifies the frequency at which the class data is polled. Valid range is 0-604800 seconds. The default values for Class 1, 2, and 3 is *0*. The default value for Integrity Polls is 3,600. Class 1, 2, 3, and 0 requests all data on the device, so for large devices this period should be at least 60 seconds, and it is recommended that it be greater than 3,600 seconds. To ensure that data is always processed in chronological order, whenever a request for class 0 data is to be made, a request for class 1, 2, 3, and 0 data (in that order) is actually made.
Max Number of Events	The maximum number of events that are requested at a time for each class. If there are events remaining in the controller's event buffer then execute repeats are configured. For more information, see the **Combine classes 1, 2, and/or 3 in a single request** property. A value of 0 retrieves all of the class's events.
Incremental Startup	If selected, the events in a controller's event buffer will be retrieved in increments, one class at a time. Urgent tasks (such as controls) or scheduled requests by other controllers in a half duplex link can be performed while the controller is starting up. If you clear this check box, all events are requested at the same time on controller startup. **Attention** The **Combine classes 1, 2 and/or 3 in a single request** check box does not affect startup. By default, this check box is selected for new controllers. Check this setting when configuring existing controllers.

Property	Description
Combine classes 1, 2, and/or 3 in a single request	If selected, requests for classes are combined together with other classes scheduled at that time. Select an option button. • **Request the maximum number of events once per poll (Do not repeat)** If selected, no action will be taken if there are events remaining in the controller's event buffer. If a controller or address is generating events faster than they are being retrieved, the DNP3 interface may not be able to keep up with the generated events until the next integrity poll. • **Repeat requests for the maximum number of events until all of the events are retrieved. Do the follow up requests only when the link is idle.** This mode is applicable to half duplex links only. If selected, repeat requests for remaining events only when there are no other actions scheduled on the half duplex link. Use this mode to prevent one controller from affecting the retrieval of other controllers on the same half duplex link. • **Repeat requests for the maximum number of events until all of the events are retrieved. Do the follow up requests only when the controller is idle.** If selected, repeat requests for remaining events only when there are no other actions scheduled for that controller. Use this mode for fair processing of controller activities when they are scheduled. • **Repeat requests for the maximum number of events until all of the events are retrieved. Do the follow up requests as the next action for the controller.** If selected, repeat requests for remaining events straight away. Other periodic actions scheduled for this controller are queued until the controller's event buffer for this class is emptied. If you clear this check box, events are requested for each class from the controller individually.

Unsolicited responses

Property	Description
Accept Unsolicited Messages	If selected, unsolicited messages from the controller are accepted and confirmed. If not selected, unsolicited messages are ignored.

Time synchronization

Property	Description
Enable Time Synchronization	If selected, the server attempts to synchronize the controller's time when the channel is brought into service and when the controller sets IIN bit 4 in its responses. If not selected, the server never attempts to synchronize the controller's time. If the **Enable LAN Time Synchronization** option is disabled, selecting this option allows the use of the standard DNP time synchronization method. The server synchronizes the controller's time by issuing a Delay Measurement (Function code 23) request then writing a Time and Date object to the controller. This method of time synchronization is only recommended for serial ports due to the non-variable nature of serial communications delays (however this setting can be selected for other port types). For LANVendor ports, an alternative synchronization method can be enabled using the **Enable LAN Time Synchronization** option.

Property	Description
Enable LAN Time Synchronization	Only applicable to LANVendor port with the **Enable Time Synchronization** option enabled. This option uses the LAN/WAN DNP time synchronization method (see the *Transporting DNP V3.0 over Local and Wide Area Networks* document). If selected, the server synchronizes the controller's time by issuing a Record Current Time (Function code 24) request then writing a Time and Date at Last Recorded Time object to the controller upon receipt of a Null response. If not selected, the standard method of time synchronization will be issued.
Class 1,2,3, & 0	Specifies the frequency at which the class data is polled. Valid range is 0–604,800 seconds. The default values are *0*. Class 1, 2, 3, and 0 requests all data on the device, so for large devices this period should be at least 60 seconds, and it is recommended that it be greater than 3,600 seconds. To ensure that data is always processed in chronological order, whenever a request for class 0 data is to be made, a request for class 1, 2, 3, and 0 data (in that order) is actually made.

Related topics

"Defining a DNP3 controller" on page 20

DNP3 controller timeouts and control properties

The DNP3 Protocol tab defines the following properties for a DNP3 controller.

Attention

Several of the settings described in the following table are marked with a (D*n*) or (A*n*), where *n* is a number. To aid in the troubleshooting, error messages in the server log associated with one of these particular settings also contain the corresponding (D*n*) or (A*n*) text.

In order for the changes to settings on the DNP3 tab (except control options) to take effect after they have been downloaded to the server, the channel and/or controller should be taken out of service and then put back into service.

DNP3 data link layer settings

Property	Description
Overall timeout (D1)	Time allowed for any complete Data link layer request. This is an overall timeout and should be set to allow for any RESET, REQUEST LINK STATUS, USER DATA, or other frames that may need to be sent in order to successfully send the data from the upper layer. Valid range from 1–30,000 milliseconds. Default is *800*.
Ack/link status timeout (D2)	Time allowed for a data link ACK or LINK STATUS RESPONSE frame to be received. Valid range from 1–30,000 milliseconds. Default is *500*.
Number of reset retries (D3)	(Only available when Acknowledgements is selected.) Number of times a data link RESET frame is resent in the event of an error. Valid range from 0–100 retries. Default is *0*.
Number of data retries (D4)	(Only available when Acknowledgements is selected.) Number of times data link USER DATA frame is resent in the event of an error. Valid range from 0–100 retries. Default is *0*.

Property	Description
Send RESET upon receipt of a NACK with clear DFC (D7)	(Only available when Acknowledgements is selected.) If selected, immediately after receiving a NACK frame with the DFC bit set to 0 the server sends a RESET LINK frame to the slave. The server interprets the receipt of such a NACK frame as meaning the slave was restarted and is waiting for it's receiving link to be reset for the first time. If not selected, the receipt of a NACK frame with the DFC bit set to 0 causes the server to behave as the same as if the DFC bit is set to 1. That is, the configured number of REQUEST LINK STATUS tests will be attempted. If the slave responds with a DFC set to 0 during these tests, the data link layer transaction will be continued. Otherwise, the data link layer transaction will be failed. Default is selected.
Send NACK with clear DFC upon receipt of a set FCV before RESET (D6)	Allows for when the server receives a frame from the slave with the FCV bit set to 1 before the server has received a RESET frame in it's current in-service session. If selected and this situation occurs, the server sends a NACK frame to the slave with a DFC bit set to 0. This should trigger the slave into sending a RESET frame to the master. If not selected and this situation occurs, the server does not send a response to the received frame. Although not discussed in the DNP3 V3 Data Link Layer specification, this option may need to be selected to ensure proper recovery when the channel or controller is taken in and out of service. Selected by default.
Acknowledgments	If selected, the slave is requested to acknowledge data link layer USER DATA frames that are sent to it by returning an ACK frame. If set, a RESET frame is sent when required to in order to synchronize the FCV bit or the master and the slave. If not selected, then the slave is not requested to confirm USER DATA frames. Not selected by default. Data link acknowledgements are not to be configured for Ethernet devices. It is also recommended that data link acknowledgements not be used for serial devices.
Number of link status tests (D5)	(Only available when Acknowledgements is selected.) Number of times a REQUEST LINK STATUS frame is sent if the slave indicates that it cannot receive any more frames. Valid range from 0–100 retries. Default is *3*.

DNP3 application layer settings

Property	Description
Fragment timeout (A2)	Time allowed for an application fragment to be received after the initial request or after receipt of the previous fragment within the response. Valid range from 1–30,000 milliseconds. Default is *6000*.
Response timeout (A3)	Time allowed for a complete application response (possibly multiple fragments) to be completely received. Valid range from 1–30,000 seconds. Default is *12*.
Maximum fragment size	Maximum number of bytes in an application layer fragment. Valid range from 249–2,048. Default is *2048*.
Number of request retries (A4)	Number of times an application layer request is retried in the event of an error. Valid range from 0–100 retries. Default is *0*.

DNP3 default control settings

Property	Description
Control function	This is the default setting for new points built on the controller and can be changed on an individual point basis. It sets which Application layer function(s) are used to control the Control Relay and Analog Output blocks. Selecting *Direct Operate* causes the Direct Operate function to be used. Selecting *Select-Operate* causes each control operation to use the Select function followed by the Operate function. Default is *Direct Operate*.
Pulse width	This is a controller-wide setting and cannot be modified on an individual point basis. It is the width of the pulse in milliseconds. Valid range is from 0–10,000 milliseconds. Default value is *200*. Note that this property is not the same as the **Pulse Width** property on the Control tab of a status point.
Control operation	This is the default setting for new points built on the controller and can be changed on an individual point basis. This setting sets whether to use Pulse On or Latch On/Latch Off when controlling Control Relay Output Blocks. If the *Pulse* setting is used without the use of Trip and Close Relays, the control operation attempts to pulse the corresponding Unpaired Momentary Relay. Default is *Latch*. Note that this property is not the same as the **Pulse Width** property on the Control tab of a status point.
Use trip/close relays	This is the default setting for new points built on the controller and can be changed on an individual point basis. This setting sets whether to use the Trip and Close relay pair when controlling Control Relay Output Blocks. If the Trip and Close relay pair is to be used for a point, the control operation for that point must be set to Pulse. This can be accomplished by setting the Control Operation property for the controller to *Pulse* by default, or by specifying *PU* on the point's address line. When the Trip and Close relay pair is used, the Trip relay is pulsed on when the point is controlled to the low state and the Close relay is pulsed on when the point is controlled to the high state.

DNP3 addresses for a point parameter value

For source addresses and destination addresses, the format for a DNP3 controller address is:

ControllerName Address

Part	Description
ControllerName	The name of the DNP3 controller.
Address	The address in the controller where the value is recorded. See the section below titled "Address syntax."

If you would like help with the address, you can use the Address Builder. To display the Address Builder, click ... next to **Address**.

Address syntax

The format for the address is:

ObjectType ObjectAddress [*DataSize*] [*ControlOptions* | *HistoryBackfill*] [B:*BitNumber* | *DataFormat*]

Part	Description
ObjectType	Object type is the DNP3 object type being specified. See the sections below titled 'Point parameter addressing options' and 'DNP3 objects options.'
ObjectAddress	Specifies the object address of the specified object type. Range is 0–32767.
DataSize	Specifies the data size of analog and counter objects, either 16 or 32 (bits). This value overrides the data size specified in the controller configuration. Short floating point analog variations may also be specified. *16*, *32* or *FP* are valid values. Long floating point analog variations are NOT supported.
ControlOptions	Applicable to BOC and AOC only: • *DO* for use of Direct Operate control function or • *SO* for use of Select - Operate control functions Applicable to BOC only: • *TC* for use of Trip and Control Relay Pair or • *NOTC* for non-use of Trip and Control Relay Pair • *LA* for Latch On/Latch Off control operations or • *PU* for Pulse On control operations **Note:** If the above settings are not specified when the point is first built, the control options for the point are set to those of the point's controller. These settings are separate from the Pulse Width setting found on the Control tab of a status point.

Part	Description
HistoryBackfill	*HIS* can be added to the address to enable any source parameter to have its history backfilled. The source parameter must also have standard history configured. History backfill is performed regardless of the state of history gating points configured for the parameter. History Backfill is only supported for status and analog point types. History Backfill must also be configured for the controller. See the topic titled 'DNP3 controller Main properties.' **CAUTION** Standard history averages are NOT re-averaged as part of the history backfill process and should not be considered accurate for points that have history backfill configured.
BitNumber	The valid range is 0 (default) to 15, where 0 is the least significant bit. The number of bits read is implied by the point type. Analog point parameters read up to 16 bits. Status point parameters read 1, 2, or 3 consecutive bits.
DataFormat	The data format acronym or starting bit number, depending on how you want the value to be read: • Data format for scaling (see the section below titled "Data format for scaling") • Data format for reading raw values without scaling (see the section below titled "Data format for reading raw values without scaling") • Data format for reading mode values (see the section below titled "Data format for reading mode values") If you want to use a user-defined data format, you must define the format on the server. See the section titled "About user-defined data formats" in the *Station Configuration Guide* for more information.

Examples

Analog point

PV source: *DNPCT 1 AI 163 FP HIS IEEEFP*

SP destination: *DNPCT_1 AO 162 16 U16B*

SP destination: *DNPCT_1 AO 200 16 SO U16B*

Mode destination: *DNPCT_1 BO 163*

Status point

PV source: *DNPCT_1 BI 201*

OP destination: *DNPCT_1 BOC 201 PU TC DO*

Accumulator point

PV source: *DNPCT_1 Co 171 C16*

Point parameter addressing options

Note that all DNP3 devices may not accept the options described here. See the device's DNP3 device profile document for more details.

Point type	Point parameter	QB entry for Object	Data size (bits)	Bit # applic.	Data format	History backfill applic.
Status	PV/OP source	BI/SOE/BO	n/a	No	n/a	Yes

Point type	Point parameter	QB entry for Object	Data size (bits)	Bit # applic.	Data format	History backfill applic.
		DBI	n/a	Yes	n/a	Yes
		AI/FAI/AO/CO /FCO	16 or 32	Yes	non-scaled	Yes
	OP destin	BOC	n/a	No	n/a	No
		AOC	16 or 32	Yes	non-scaled	No
Accumulator	PV source	AI/FAI/AO/CO /FCO	16 or 32	No	non-scaled	Yes
Analog	PV/SP/OP/A1-A4 source	CO/FCO	16 or 32	No	all	Yes
	PV/SP/OP/A1-A4 source	AI/FAI/AO	16, 32, or FP	No	all	Yes
	SP/OP/A1- A4 destin	AOC	16, 32, or FP	No	all	No
Status or analog	Mode source	BI/BO	n/a	No	n/a	Yes
		DBI	n/a	Yes		Yes
		AI/FAI/AO/CO /FCO	16 or 32	No	mode	Yes
	Mode destin	BOC	n/a	No	n/a	No
		AOC	16 or 32	Yes	mode	No

DNP3 objects options

Object type	Object type description	DNP3 object type #s	Variation description
BI	Binary Input	1	With or without status.
DBI	Double-bit Binary Input[1]	3	With or without status.
SOE	Binary Input Event	2	With or without status, can have timestamps.
BO	Binary Output[1]	10	With status.
BOC	Binary Output Command	12	
CO	Counter[1]	20	16-bit or 32-bit, with or without status. Delta counter variations are NOT supported.
FCO	Frozen Counter[1]	21	16-bit or 32-bit, with or without status. Delta counter variations are NOT supported.
AI	Analog Input[1]	30	16-bit, 32-bit, or short floating point, with or without status.
FAI	Frozen Analog Input[1]	31	16-bit, 32-bit, or short floating point, with or without status.
AO	Analog Output[1]	40	16-bit, 32-bit, or short floating point.
AOC	Analog Output Command	41	

[1] Any periodic scans request static variations but both static and event groups are accepted from the controller and processed.

SOE configuration

The SOE enable flag must be set for the controller, and status points must have their PV source address specify SOE as the object type. Do not build two point/parameters where one uses the SOE object type and the other uses the BI object type with the same object address.

Data format for scaling

You can scale point parameter values with a data format. Select the format that corresponds to the raw data range in the controller.

When analog input deadbands are used, the absolute deadband value written to the controller for scaled data formats is the deadband percentage of the raw data range specified in the Description column below. For data formats that are not scaled, the absolute deadband value written to the controller is a percentage of the point's EU High and Low range.

Data format	Description	Scaled
C16	0–65535	No
HALFWD	0–65535	No
U100	0–100	Yes
U1023	0–1023	Yes
U4095 (default)	0–4095	Yes
S9999	–9999–9999	Yes
U9999	0–9999	Yes
U9998	0–9998	Yes
U999	0–999	Yes
U8B	0–255	Yes
U14B	0–16383	Yes
U15B	0–32767	Yes
U16B	0–65535	Yes
S8B	–128–127	Yes
S16B	–32768–32767	Yes
S32B	–2,147,483,648–2,147,483,647	No
U32B	0–4,294,967,296	No
IEEEFP	IEEE single precision floating point range	No
REVWD	0–65535	No
U3BCD	0–999 in binary coded decimal	Yes
U4BCD	0–9999 in binary coded decimal	Yes
LOWWORD	0–65535	No
HIGHWORD	0–65535	No

Attention
If auxiliary parameters have a data format type that requires scaling, they take the same range as the PV.

Data format for reading raw values without scaling

To read less than 16 bits without scaling, enter the starting bit number (1–15).

If you are not using scaling, the point range is still used for PV indicator bar height only (the PV indicator bar is on the Point detail display on Station).

Data format for reading mode values

By default, modes are 1-bit values unless the 'mode' keyword is specified; then modes are 4 bits wide.

Related topics

“DNP3 controller levels” on page 23
“DNP3 controller Main properties” on page 20
“Using the Address Builder to enter an address” on page 33

Using the Address Builder to enter an address

To specify a DNP3 controller address, enter the following property values.

Property	Description
Address Type	Select *Controller*.
Controller	Select the appropriate DNP3 controller. You need to have defined the controller for the name to appear in this list.
Address	The address in the controller where the value is recorded. See the topic titled "DNP3 addresses for a point parameter value."

Related topics

“DNP3 addresses for a point parameter value” on page 29

Optimizing scanning performance

In general, periodic polling for, or the unsolicited reporting of, DNP3 Class 1, Class 2, and Class 3 events should be used in preference to periodic polling for static data.

The maximum amount of static data that can be acquired from a controller is influenced by the rate of sending scan packets to the controller. You should gain an understanding of DNP3 scan packets in order to optimize data acquisition performance, and maximize the amount of data acquired with each scan packet.

You can list scan packets that have been built with the list scan utility, **lisscn**. Listing scan packets helps verify the scanning strategy. For information about the **lisscn** utility, see the *Station Configuration Guide*.

The ability to optimize scanning depends upon the DNP3 controller type used:

- Level 1 controllers should use RBE (class polls) and/or unsolicited responses to achieve efficient scanning. Class 0 polling should be carried out at a low frequency or avoided completely.
- Level 2 controllers should also use RBE and unsolicited responses to achieve efficient scanning. Point parameters should not be polled at a high frequency because it causes read requests for complete object types to be sent to the device, at a rate equal to the fastest Point frequency configured for that object type.
- Level 3 controllers allow for efficient scanning by combining DNP3 object types into blocks (see the following table) of DNP3 objects with similar scanning periods.

DNP3 object type	DNP3 level 3 maximum block size
BI/BO/SOE	233
16 bit AI/AO/Co	127
32 bit AI/AO/Co	85

Server and Station tasks for DNP3

This section describes tasks for the DNP3 controller that you perform either on the server or from any Station.

Related topics

“Testing DNP3 communications with the server” on page 36
“Troubleshooting DNP3 scanning errors” on page 37

Testing DNP3 communications with the server

You use the DNP3 test utility, **dnptst**, to test communications between the server and the controller after you have downloaded your channel and controller definitions to the server database.

Prerequisites

Before testing:

- Set up the controller.
- Connect all cables.
- Define the controller and channel in Quick Builder.
- Download the Quick Builder definitions to the server without errors.
- Ensure the channel is out of service.

To run the dnptst utility

1. Open a Command Prompt window.
2. Type **dnptst** and press ENTER.
3. Follow the directions as prompted.

Troubleshooting DNP3 scanning errors

If the Point Detail display for a point shows a bad value (indicated by inverse video), then the point might be built with an address that is syntactically valid but not configured in the controller. If this is the case refer to the Event Log, where there should be an event describing the problem.

Note the following items:

- Some DNP3 devices return an error if a block of objects is requested from it and one of the objects in the block doesn't exist. In this case the valid objects may not even be returned. The solution is to ensure all DNP3 objects in the controller are in contiguous addresses.
- If a controller sends data to the server as unsolicited data, or in response to a class poll request, and the size variation differs from that specified in a point/parameter address, then that point/parameter is not processed. The solution is to specify the correct size (16 or 32) in the point/parameter address.
- If scanning errors occur in DNP3 level 2 devices then all points built on the controller are processed to BAD.
- The DNP3 daemon may run out of transaction table slots if the channel is overloaded or if there any large numbers of controllers on the channel. The channel will be failed when this occurs and may be recovered by periodic diagnostic requests. In such overload conditions, the number of transaction table slots can be increased using the settings on the channel's Port tabs.

Related topics

“DNP3 channel Port properties” on page 16

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  or

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